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Chicago Region Airport Trip Generation

Process Documentation

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CMAP Congestion Management Process

Chicago Region Airport Trip Generation
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To compete in modern global markets, metropolitan Chicago requires a global economic reach, which in turn requires aviation. Regional prosperity is tied to a strong aviation system. However, this system requires additional investment, which in turn requires understanding how the aviation system works. This paper investigates the interactions between forecast aviation activity and the region's surface transportation system.

As the Chicago area grows, so will air travel. The seven-county metropolitan population is projected to grow from 8.3 million to more than 10 million by 2030. Annual enplanements (aviation boardings) at the South Suburban, Midway, O'Hare, and Gary Airports are forecast to increase from 46 million in 2006 to 81 million in 2030. To accommodate this projected growth, plans are in place to add airside, terminal, and landside capacity for the Chicago Aviation System and at the proposed South Suburban Airport.

Table 1 shows the projected growth in metropolitan Chicago enplanements.

Table 1
Actual and Forecast Enplanements (Millions)
for Metropolitan Chicago and Gary Airports, 2000—2030

Airport	*2000(A)*	*2006(P)*	*2007(F)*	*2010(F)*	*2020(F)*	*2030(F)*
O'Hare	33.8	36.8	36.5	39.8	52.4	63.4
Midway	7.1	8.9	10.8	12.2	12.0	12.0
SSA ('04)	0.0	0.0	0.0	0.2	2.5	9.0
Gary	0.0	0.0	0.1	0.1	0.1	1.3
Total	40.9	45.7	47.4	52.1	67.8	**81.2**

Notes: A = Actual; P = Preliminary; (Source: FAA (1) [Federal Aviation Administration]. *Passenger and All-Cargo Statistics.* http://www.faa.gov/airports_airtraffic/airports/planning_capacity/passenger_allcargo_stats/ Accessed August, 2007.) F = Forecast. Source: CATS (Chicago Area Transportation Study—CMAP's predecessor agency), 2005, internal data used for 2006 regional travel demand models. This data was the result of analysis of Federal Aviation Administration data and estimates by the Illinois Department of Transportation, with input from the Chicago Department of Aviation; SSA ('04) reflects 2004 CATS estimates of SSA activity used for the 2006 RTP update. Current estimates of SSA enplanements compiled in 2006 by the al Chalabi Group are approximately half the CATS estimates above for each analysis year.

The estimates show higher short-term aviation growth at Midway, followed by substantial growth at O'Hare, followed by growth at South Suburban Airport. Long-term federal enplanement forecasts were judged significantly too high when the CATS estimates were compiled, especially for Midway. Thus, the estimates in Table 1 are substantially lower than the estimates used in 2003. Total enplanements reflect 2.5% annual total system growth.

Chicago Region Airport Trip Generation
Regional Originating Enplanements

Air carriers serving the Chicago market use the Chicago aviation system as an operational hub. Thus, some regional airport enplanements don't originate in metropolitan Chicago, but only connect from other flights outside the Chicago area. These connecting itineraries are assumed not to have a direct impact on airport trip generation, though they have an indirect impact through employment.

Projecting future connecting enplanements requires more assumptions than originating enplanements, since such assumptions include airlines' strategic approaches. In fact, these private industry approaches may change over time, though they are responsive to public infrastructure investments. For this analysis, it was assumed that the current hub-and-spoke system would remain in place, with substantial connecting flights at hubs like Chicago O'Hare International Airport. In addition, while Midway for many years operated with nearly all originating passenger trips, it has more recently developed into a regional hub for Southwest Airlines.

Table 2 shows the projected changes in originating enplanements over time.

Table 2
Estimated and Forecast Percent of Enplanements from Originating Itineraries for Metropolitan Chicago and Gary Airports, 2000—2030

Airport	*2000(E)*	*2007(F)*	*2010(F)*	*2020(F)*	*2030(F)*
O'Hare	41.7%	43.4%	45.0%	47.6%	47.6%
Midway	80.0	67.0	67.0	67.0	67.0
SSA ('04)	N.A.	N.A.	100.0	95.0	67.0
Gary	N.A.	100.0	100.0	100.0	80.0
All Airports	48.6%	48.7%	50.4%	52.9%	52.8%

Notes: E= Estimate; F= Forecast. O'Hare data from O'Hare Master Plan, with a horizon year of 2018. 2018 forecasts were applied to 2020 and 2030 scenario years. Midway data from Department of Aviation internal data. 2004 data applied to 2007 and succeeding analysis years. South Suburban Airport originating enplanements are assumed to follow the pattern of Midway.

Regional originating enplanements were forecast to rise at a slightly faster pace than total enplanements. Much of this regional change is due to forecast changes at O'Hare.

Overall, about half of the forecast enplanements in the region will be for passengers with itineraries originating at the region's airports.

Chicago Region Airport Trip Generation
O'Hare Airport Employment Indicators

Chicago-O'Hare and Chicago-Midway Airports are both regionally important employment centers. However, in analyzing previous forecasts, there appeared to be discrepancies in such data as authorized airport employee passes, transit usage, employee parking spaces, and with employment totals used in travel demand forecasts. While socioeconomic forecasts used for travel demand modeling in 2003 estimated current O'Hare employment totals of greater than 70,000, the other data points indicated O'Hare employment in a range approximately half that, so more modest numbers were used in 2006. Here are some of the employment data indicators of the airport:

Census Journey-to-Work Data:
The U.S. Census Bureau compiles journey-to-work information by geographic area as small as "traffic analysis zone." In metropolitan Chicago, most of O'Hare is represented by traffic analysis zone (TAZ) 1194. A small part of the southwest cargo complex is also in TAZ 3355. (A map of O'Hare area TAZ's is in Appendix 2 of this report.)

In 2000, employment in TAZ 3355 totaled 33. Census employment in TAZ 1194 totaled 33,591. Of these, 1,628 commute from outside the 37-county greater Chicagoland area and do not arrive via auto, ridesharing, or transit—since they are not commuting in the traditional sense (we hypothesize they are flight crews), they were not included in the trip generation for O'Hare. The origin and journey-to-work data for O'Hare workers are shown in Table 3.

Table 3
Census 2000 O'Hare Airport Journey-to-Work Data

Location	*Drove Alone*	*Carpool*	*Bus*	*Rail*	*Other*	*Total*
Chicago	7,774	1,642	1,522	2,559	212	13,708
Suburban Cook	8,096	902	156	174	64	9,392
DuPage	2,502	142	0	14	36	2,694
Kane	846	52	0	0	0	898
Kendall	47	8	0	0	0	55
Lake	1,026	78	0	0	14	1,118
McHenry	831	49	0	7	0	887
Will	762	98	0	14	0	874
Other	1,933	155	145	64	1,668	3,965
Total	23,817	3,126	1,823	2,832	1,994	**33,591**

Source: RTAMS, www.rtams.org. Accessed November, 2007. Data represents TAZ 1194.

Chicago Region Airport Trip Generation
O'Hare Employment Indicators (Continued)

Employee Parking:
For the O'Hare Airport master planning process, an inventory of employee parking has been developed. Most employee parking spaces are in the non-terminal areas. Table 4 shows the number of parking spaces by airport sector for 2001 and 2018, the horizon year for the O'Hare Modernization Program.

Table 4
Employee Parking, O'Hare International Airport

Airport Area or Location	2001 (A)			2018 (F)		
	Terminal & Flight Crew	Ancillary & Support	Total	Terminal & Flight Crew	Ancillary & Support	Total
East Facilities	0	996	996	2,595	0	2,595
Northwest Maintenance	6,467	3,121	9,588	7,990	3,301	11,291
Southeast Service	1,134	1,889	3,023	1,134	1,657	2,791
Southwest Cargo	0	3,113	3,113	3,540	4,731	8,271
Total	7,601	9,119	16,720	15,259	9,689	24,948

Notes: Source: O'Hare International Airport Master Plan, Section 2.7, Table IV-10, Section 4.4, and Section 5.4. http://www.ohare.com/MasterPlan/ Accessed November, 2007. (A) = Actual; (F) = Forecast. East Facilities include current East Cargo Area and future Lot F terminal employee and flight crew parking facility. Northwest Maintenance area includes the proposed Northwest Employee Lot. Southwest Cargo includes the proposed employee parking facility for the proposed West Terminal.

The O'Hare Master Plan (section 2.7.3) shows that employee parking peak occupancy on a sample day in April, 2002 was 83%. Employee parking turnover at O'Hare is high. The workday at O'Hare is very long; departing passengers flood into the terminal area beginning at 4:00 a.m. Departing flights continue in large numbers until 10:00 p.m. (see Appendix 1).

With census data indicating O'Hare average auto occupancy of 1.07, an auto mode share of 80% for employees, a parking occupancy rate of 83%, and a daily parking turnover rate of 2.0, the parking characteristics would support weekly average employment in 2001-2002 of about 37,000.

Badges.
Preliminary employee badge counts in April 2004 were approximately 39,600. Since these included some flight crews and part-time employees, average weekly Census-equivalent employment is likely substantially below this total.

Chicago Region Airport Trip Generation
Modeling O'Hare Trip Generation

From 2004 to 2006, CMAP improved the manner in which O'Hare was represented in travel demand models. Weaknesses had been noted in the 2003 models. In addition to employment and enplanement estimates from 2003 that were too high, travel demand modeling in 2003 and in previous years used a very simplified version of an O'Hare transportation network. To accompany this, the travel demand model generated all airport terminal trips and most employment trips from a single centroid. The old zone structure and accompanying highway network are shown in Appendix 3.

More information about O'Hare development plans enabled substantial improvements in modeling O'Hare terminal trips and ancillary facility trips. The effect of this was to distribute employment and enplanement trip generation to more zones. Table 5 shows how O'Hare International Airport activities and areas are assigned to various zones in CMAP's Zone06 system.

Table 5
O'Hare Airport Areas and Activities by CMAP Zone06

Zone	Description	Terminals	Activities
89	Northwest Maintenance	N.A.	Airport Only, including Maintenance and Employee Parking
90	UAL	N.A.	Off-Airport. No Airport Activities
91	East O'Hare Business Park	N.A.	No Airport Activities
92	Core O'Hare	1, 2, 3, 4 (F)	Terminal Only
93	East O'Hare	5, 6 (F)	Terminal Only
94	Far East	N.A.	Airport Only, including Car Rental, Passenger and Employee Parking
95	Rosemont	N.A.	Off-Airport. No Airport Activities
96	Southwest Cargo	N.A.	Airport Only, including Employee Parking, Cargo
97	Southeast Service	N.A.	Airport Only, including Employee Parking, Flight Service
1395	Far West	N.A.	Airport Only. None identified
1401	West O'Hare	7 (F)	Terminal Only

Source: CMAP. (F) indicates future terminal. Off-Airport zones are identified only for information. Terminals include existing and future associated satellite concourses.

Chicago Region Airport Trip Generation
Modeling O'Hare Trip Generation (Continued)

Special Considerations in Airport Trip Generation

Standard trip generation procedures produce estimated trips by trip purpose to include not only the home-to-work trips and external trips you would expect for airports, but home-to-other and non-home-based trips. However, because of security and operational limitations, the latter types of trips to airports are limited. Airport trip generation prior to 2006 included not only enplanements (modeled as external trips) and home-based work trips, but substantial non-work and non-home-based trips. For 2006, non-airport related activities were zeroed out as a post-processing step for trip generation procedures, including home-based other productions and attractions and non-home based productions and attractions (in addition, since there is no resident population in these zones, home-based productions were zeroed out as a safety factor). Zones where non-airport trip generation was zeroed out included zones 89 (Northwest Maintenance); 92 (Core O'Hare); 93 (East O'Hare); 94 (Remote O'Hare); 96 (Southwest Cargo); 97 (Southeast Service); 1395 (Far West); and 1401 (West O'Hare).

Forecast Gate Frontage by Zone

This paper earlier provided estimates of enplanements by airport and scenario year. However, with additional centroids representing terminal areas at O'Hare, estimation of enplanements by terminal area was required for each scenario year. Allocation of enplanements was assumed to be proportional to the forecast gate frontage of the zone's terminals. Table 6 shows how gate frontage is forecast to be allocated by zone for each scenario year.

Table 6
O'Hare International Airport Forecast Gate Frontage (in Linear Feet)
by CMAP Zone06

Zone	*Terminals*	*2000*	*2007*	*2010*	*2020*	*2030*
92/Core	1, 2, 3, 4 (F)	21,559	21,559	24,559	23,195	23,195
93/East	5, 6 (F)	3,970	3,970	3,970	6,566	6,566
1401/West	7 (F) (See Note)	0	0	0	8,700	8,700
Total	-	25,529	25,529	28,529	38,461	38,461

(F) indicates future terminal. Sources: *O'Hare International Airport Master Plan,* 2004, Sections 6.2, 7.1.4, 7.1.8, 7.1.9, and 7.2. http://www.ohare.com/MasterPlan/ Accessed November, 2007. Note: Year 2010 Core gate frontage includes the West Satellite Concourse, which the Master Plan indicated will be completed in 2009 before the West Terminal facility and associated western ground access is completed in 2013. This satellite concourse is re-allocated and the new Western Terminal is allocated to the West O'Hare zone (1401) in scenario year 2020 and beyond. Future Terminals 4, 6, and the proposed extension of Concourse K are also forecast as operational for the 2020 scenario year and beyond. The values above reflect the data as it was used for regional travel demand modeling in 2006.

Chicago Region Airport Trip Generation
Regional Daily Enplanements by Zone

Given the assumption that enplanements for O'Hare are distributed by forecast gate frontage, and given earlier total forecasts of enplanements, it is possible to estimate daily enplanements by zone for regional travel demand modeling.

Daily enplanements tend to be greatest on Monday mornings. However, the travel demand models do not differentiate among different weekdays. This, and the prevalence of recreational travel, led us to divide annual enplanements by 365 to arrive at daily numbers. Table 7 shows daily forecast enplanements by CATS zone and forecast year.

Table 7
Regional Daily Enplanement Forecasts by Year by CMAP Zone06

Zone	*2000*	*2007*	*2010*	*2020*	*2030*
92/O'Hare Core	34,454	37,555	42,282	41,216	49,863
93/O'Hare East	6,345	6,916	6,835	11,667	14,115
1401/O'Hare West	0	0	0	15,459	18,703
208 Midway	17,175	19,738	22,328	22,027	22,027
1671 SSA	0	0	464	6,439	16,521
1773 Gary/Chicago	48	145	187	261	2,849
Total	58,022	64,354	72,096	97,069	124,078

Source: CMAP

Discussion: Regional Enplanements Forecasts and Capacity
Current plans to expand aviation airside, terminal, and landside capacity have been endorsed by regional planning agencies and state governments, and are being actively pursued by committed implementing agencies. However, beyond these plans, large capital outlays for additional airport capacity may make accommodating additional growth beyond the above forecasts increasingly expensive and wanting for identifiable financing.

Further research is suggested in the following areas:

- Refinement of long-term enplanement forecasts. Geometric growth in forecasts may or may not be sustainable beyond 2030. Applicability of airline economics to the forecast would be helpful, though admittedly difficult.
- Investigation of congestion pricing of airside capacity at peak periods.
- Determination of the role, if any, of regional rail, particularly for short–haul flights, and the ability to integrate such rail service into connecting flights to extend airport markets, address long-term airside capacity constraints, and enhance regional mobility.

Chicago Region Airport Trip Generation
Regional Employment by Zone

With base employment estimates, a refined zone system, and an assumption that employment will grow proportionally to enplanements, CMAP was nearly able to generate employment forecasts by zone by year. The last outstanding issue was handling remote parking for terminal employees.

Given the remote parking for flight crews and terminal employees and also given the internal shuttle systems for those employees, one possibility was to assign them to remote zones, roughly following the distribution in Table 4. Under this scenario, trip distribution and modal split would be hard-coded: terminal employees assigned to terminal zones would be transit users, others would be auto users. However, such a scenario would be unresponsive to changes in travel conditions. Since the purpose of travel demand modeling is to forecast such responsiveness, such data handling was judged inappropriate. Therefore, terminal employees and flight crews were assigned to terminal zones. The resulting socioeconomic forecasts were used in 2006 travel demand modeling.

Table 8
Regional Aviation Employment Forecasts by Year by CMAP Zone06

Zone	*2000*	*2007*	*2010*	*2020*	*2030*
92/O'Hare Core	19,425	19,881	22,097	20,363	24,635
93/O'Hare East	3,577	3,661	3,572	5,764	6,974
1401/O'Hare West	0	0	0	7,638	9,240
89/Northwest Maintenance	2,932	3,001	3,272	4,304	5,207
96/Southwest Cargo	4,541	4,648	5,067	6,666	8,064
97/Southeast Service	1,657	1,696	1,849	2,432	2,943
208 Midway	5,189	7,120	8,054	7,946	7,946
1671 SSA	0	0	112	1,638	5,960
Total	37,321	40,007	44,023	56,751	70,969

Source: CMAP

Discussion: Airport Terminal Employment Travel Choices

- More study and perhaps better modeling of travel choices for flight crews and terminal employees might be helpful.

Chicago Region Airport Trip Generation
Conclusion

This short paper has documented how the aviation system for metropolitan Chicago interacts with the surface transportation system. Employee trips and originating enplanements were discussed in detail.

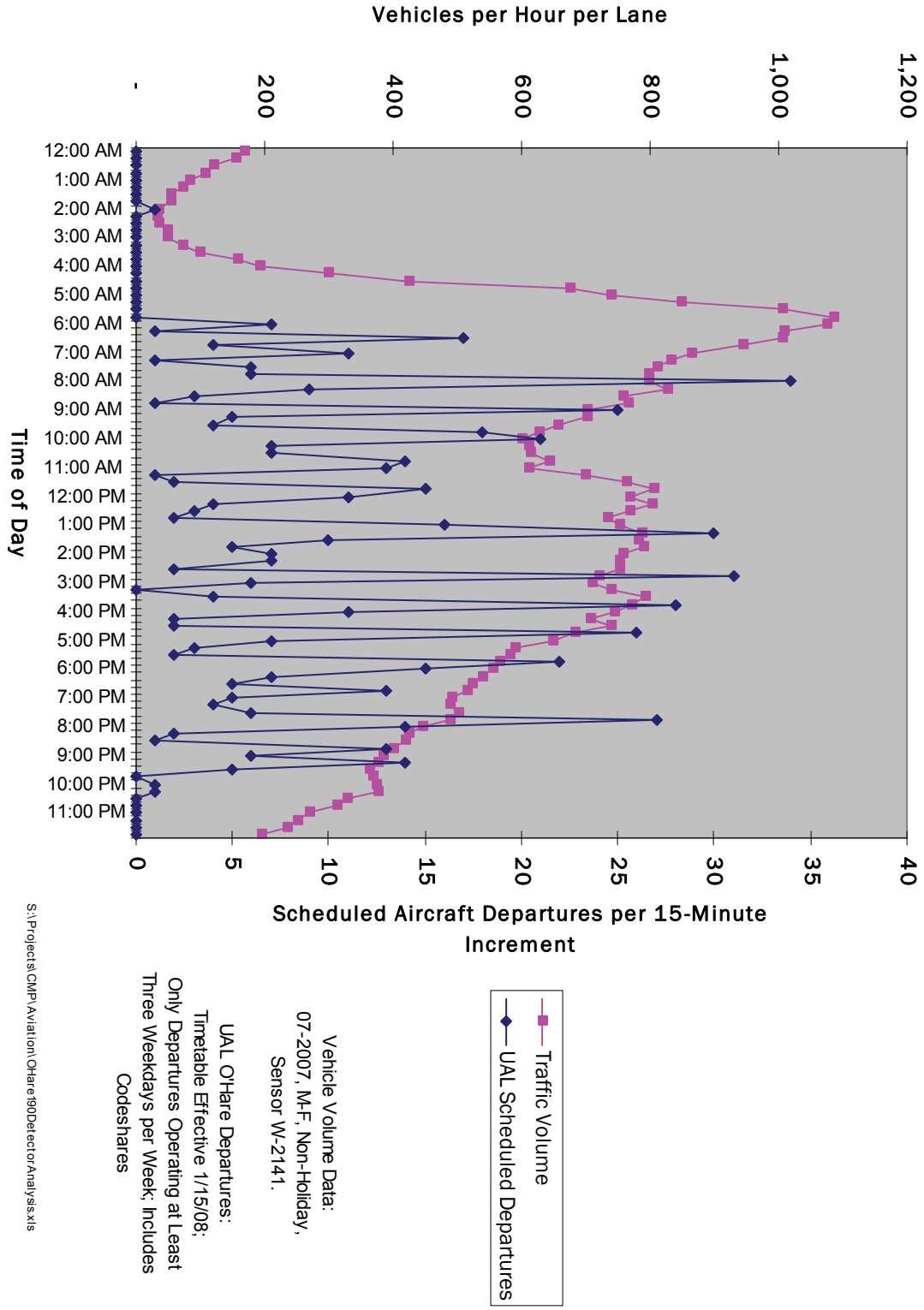
How these trips are modeled in regional travel demand models was a particular focus. Having seen in 2003 model runs that too many trips were being generated by airports, particularly O'Hare, the following improvements were implemented for 2006 travel demand modeling:

1. Only flight itineraries originating or destined to Chicago were assumed to generate surface transportation trips. Using only originating itineraries reduced the impact of enplanements at O'Hare by more than 50%.
2. Employment generated by aviation activity was reviewed. Multiple sources of transportation data indicated that O'Hare employment, while substantial, was approximately half what was modeled in 2003.
3. Normal travel demand procedures generate not only home-to-work trips, but non-home-based trips and home-based other (non-work) trips. However, the nature of airports is to limit activity other than air travel and employment. Therefore, these trips were zeroed-out in revised travel model procedures for airport centroid.
4. In 2003 and earlier years, O'Hare was modeled with a single centroid. For 2006, a better understanding of future plans allowed multiple centroids from which to generate trips for ancillary activities (maintenance, service, and cargo) as well as multiple terminal areas (core, east, and the proposed west terminal area). These new centroids allowed trips to be distributed over a wider network of surface transportation facilities around O'Hare.

Topics of additional study were identified in the paper, including enplanement forecasts beyond 2030, the potential role of regional rail, and better modeling O'Hare employee route and mode choices in the regional travel demand models.

Chicago Region Airport Trip Generation

Appendix 1: Airline Departures and Westbound I-190 Trips



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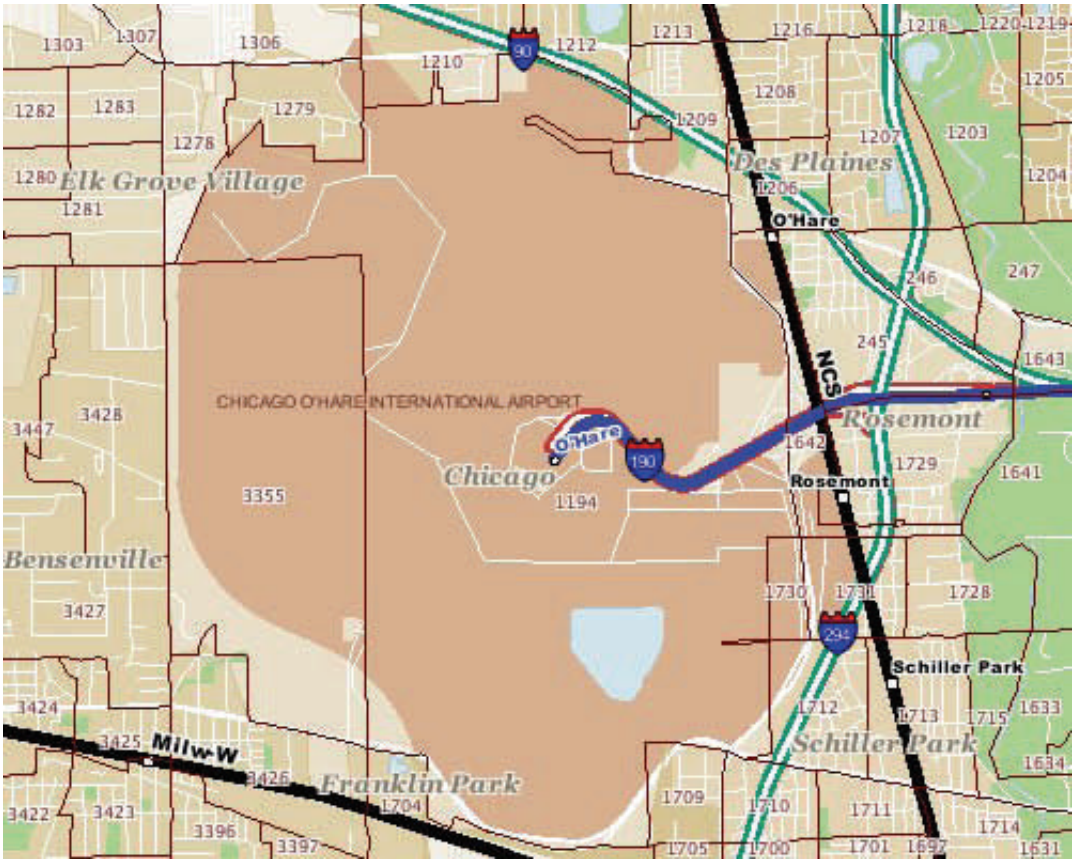
Appendix 2: O'Hare Census 2000 Traffic Analysis Zone Map



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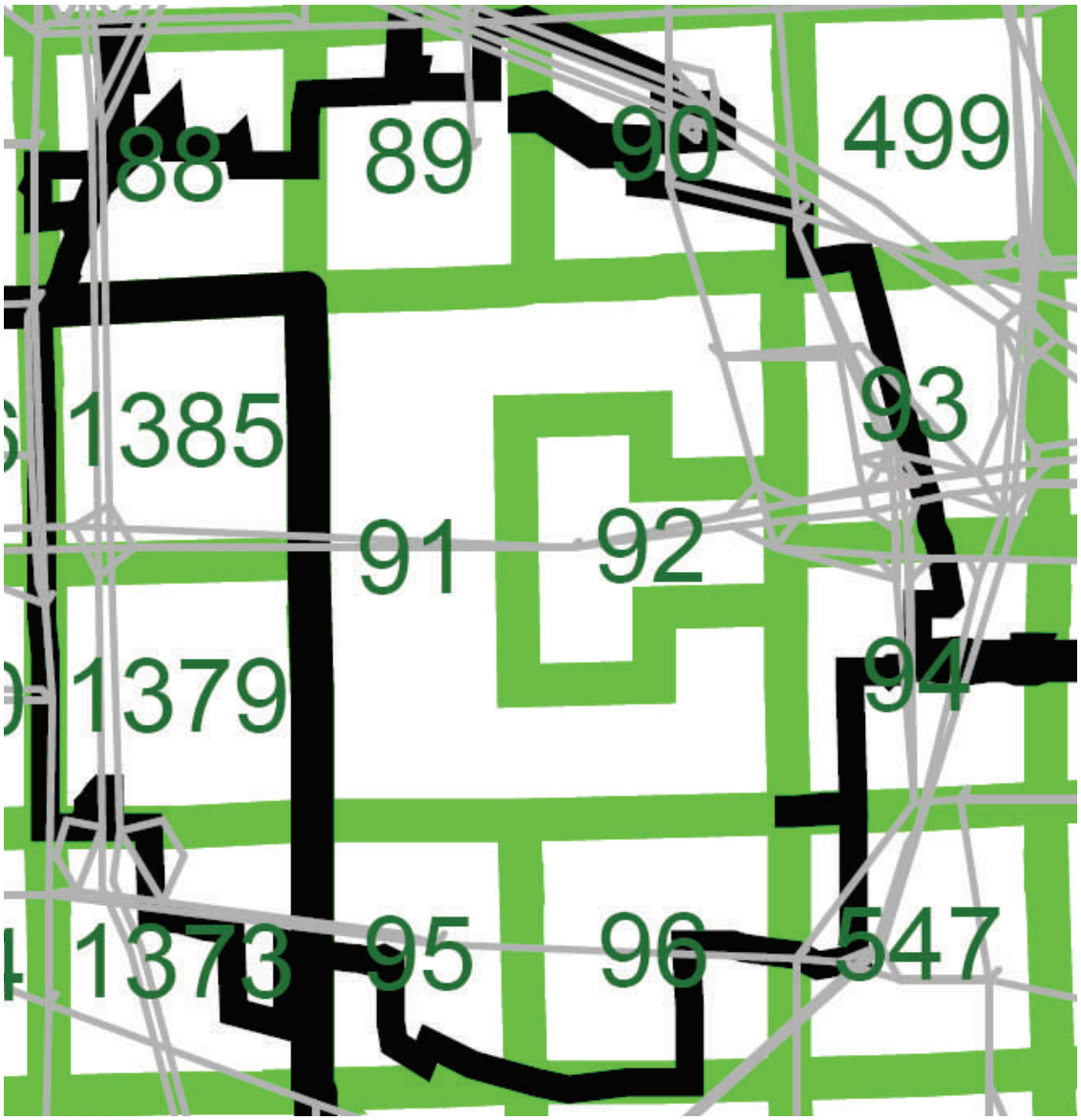
Appendix 3: 2004 O'Hare Zone and Highway Network



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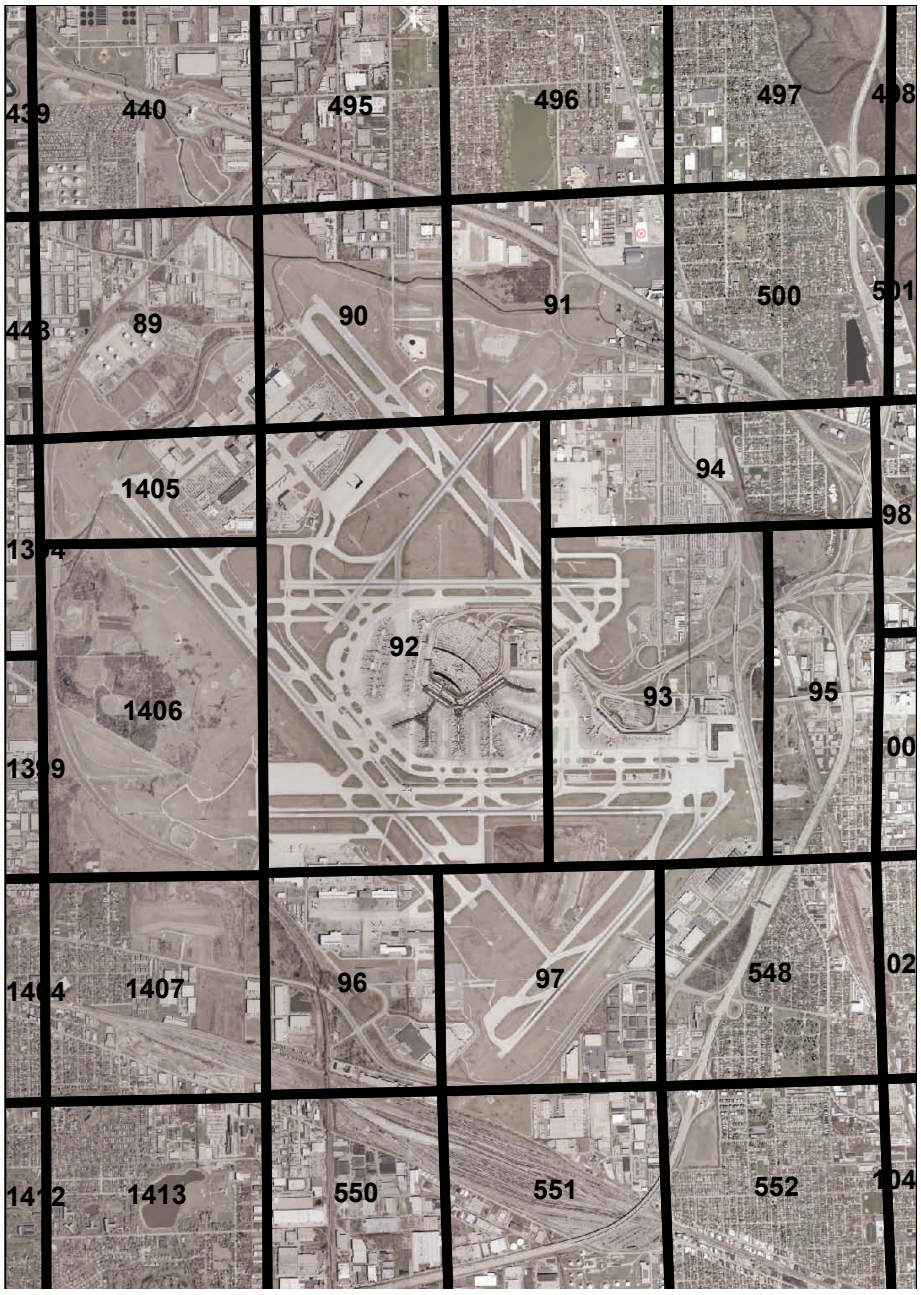
Appendix 4: 2006 O'Hare Zone System



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Appendix 5: 2006 O'Hare Highway Network (2030 Scenario)